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The Welsh Engineers' and Founders' Association

The Foundry Trades' Equipment and Supplies Association

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B.S.991

Under this number the British Standards Institution has issued for the Iron and Steel Control a data book* containing information on the properties of modern cast iron, including grey and white irons, high-duty and special alloy irons and, finally, malleable. The data book has been prepared by the Technical Advisory Panel to the Directors for Iron Castings, and the onus of its preparation has fallen mainly on the shoulders of Dr. Everest, its secretary. This panel, as is well known, includes members of the Technical Committee of the Institute of British Foundrymen, of the British Cast Iron Research Association and of various Government departments, and the data book can therefore be accepted as fully authoritative. Written primarily for engineers and designers, it fulfils a long-felt want for a work of reference giving information on the cast irons now available as the result of foundry developments during the past 10 or 20 years. In this respect it should replace the generally low figures quoted in some of the engineers' handbooks, and which, too often, though out of date, constitute the basis of engineering design to-day wherever iron castings are concerned.

Whilst the data book is intended primarily for engineers, it is of interest to all foundrymen and especially to those engaged in the production of high-duty castings. It contains much information on all those properties of cast iron not covered by specification but so often required in engineering design. It is particularly important that all progressive foundrymen should have this information at their elbow, not only for reference purposes when required but also so that they know what figures are now being used by engineers in their calculations.

The data book is based primarily on the British Standards 321 and 786, covering general grey-iron castings and 309 and 310 for malleable. It opens with a classification for cast iron developed in the first place by Pearce for his reports to the Institution of Mechanical Engineers. After reviewing the data covered by the specifications for grey-iron castings, information is given on the other mechanical and physical properties referred to above. Modification of properties by heat-treatment is considered in some detail and then various special surface treatments for the production of special properties. Information is presented on the more specialised martensitic and austenitic cast irons and finally, in the last section of the book, data are collected on the grades of malleable in general production. Appendices list the British Standards covering both general and special iron castings and also give a comparison of British and U.S.A. specifications.

The appearance of B.S.991 is particularly opportune at the present time when so much attention is being given to such problems as the conservation of supplies and to the economic utilisation of substitutes. Thus there is a tendency now being felt to use high-duty cast iron wherever possible to replace steel or malleable, or in some cases to replace certain non-ferrous alloys. This aspect of wartime engineering is emphasised in a letter signed by Colonel Llewellin, which has been circulated with the data book to Government departments and other official bodies. As foundrymen we may express the hope that the information now in the hands of the engineers will be used with discretion and always bearing in mind the limitations of even the best products of the iron-foundry. In any case of serious doubt as to the ability of cast iron to stand up in place of other stronger and more ductile materials, advice should be sought from the appropriate technical advisory bodies set up for the assistance of the industry.

Undoubtedly this data book will bring fresh demands for the production of high-grade castings, which from their very nature should command a price commensurate with the extra technical control, special raw materials and the cost of alloy additions necessary for their production. In some cases foundries, perhaps not occupied to capacity, may be tempted to undertake such work without any previous experience of high-strength castings production. The dangers which may arise in such cases are obvious, and unless a foundryman can keep his carbon, silicon and phosphorus all really low and under close control, it is useless his attempting to meet the higher grades of B.S.786 or to offer castings as substitutes for malleable or steel.

Obviously the production of high-duty cast iron calls for supplies of some of those raw

(*Continued overleaf.*)

* Data on Cast Iron. Published by the British Standards Institution, 25 Victoria Street, London, S.W. Price 5/5 post free.

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Book Review

Researches on the Structure of Alloys. By W. Hume-Rothery, F.R.S. Published by the British Non-ferrous Metals Research Association, Euston Street, London, N.W.1. Price 2s. 6d.

During more than fifteen years Dr. W. Hume-Rothery has been responsible for a remarkable series of researches on metallic alloys carried out in the laboratories of the University of Oxford. This work has been directed mainly to the establishment of the general principles which decide (1) whether and in what proportions two or more metals are capable of forming solid solutions, (2) the structural and equilibrium characteristics of alloy systems, and (3) the properties of alloys. These are, in fact, the general principles of physical metallurgy. In the course of the large amount of delicate and accurate experimental work involved, new and improved techniques of various kinds have been developed. The investigations so far completed have been published in more than thirty Papers in the "Proceedings of the Royal Society," the "Journal of the Institute of Metals," and elsewhere. The practical importance of the work, apart from its great scientific interest, lies in its promise of providing means for forecasting the properties of alloys from the atomic characteristics of the constituent metals and thus permitting the building up of alloys of desired properties.

For some years past the British Non-Ferrous Metals Research Association has made a contribution towards the cost of these investigations, and Dr. Hume-Rothery has now written a concise account of the work done since this support began. In this clear review of 20 pages' length Dr. Hume-Rothery has been more concerned to set out the plan, aims and main conclusions of his work than to give the detailed results which are published elsewhere. Nevertheless he has found it possible to indicate broadly the experimental results obtained and the evidence on which his conclusions rest. A list of the published Papers mentioned is appended to the report. Dr. Hume-Rothery's work is of fundamental importance to metallurgists, physicists and chemists, and the present report should be useful as a summary to those who have read the original Papers and to all others who are interested in the scientific study of metals and alloys.

Foundry Query

Breaking Up Big Castings

A small country foundry owner wishes to know how it can be made possible to use valuable scrap, such as heavy flywheels, bosses, chunky lumps, etc. Can anyone kindly suggest a method of breaking these small enough to melt, say, about 1-cwt. pieces? We have a ball, but that is a slow process to break small enough. Is the use of cartridges very risky? Is it permissible or does permission have to be obtained? Any advice or assistance would be welcomed.—"Country Foundry Owner."

[We would suggest the use of the oxygen cutting lance.—Editor.]

SCRAP SAVES SHIPPING SPACE

At present we have to import much of our paper requirements for munitions, 25,000 tons of shipping space being thus employed. Help to collect waste paper in this country and release tonnage to carry munitions to our Russian Allies.

SAVE WASTE PAPER

Institute of Vitreous Enamellers

A meeting of the Southern Section of the Institute of Vitreous Enamellers was held in London last Saturday, Mr. G. H. Abbott in the chair. Further consideration was given to the study of the raw materials of the vitreous enamelling industry and a comprehensive scheme for future work was discussed and agreed on. Mr. G. H. Abbott has resigned the chairmanship of the Southern Section, on taking up a post in Manchester, the meeting passing a vote of thanks for his past services in maintaining the activities of the Section, and wishing him every success in his new sphere. Mr. Alistair McLeod, Editor of "Sheet Metal Industries" and honorary secretary of the Section, was elected to succeed Mr. Abbott in the chair. Pending the appointment of a new honorary secretary at the next meeting, Mr. E. R. Francis, assistant editor, "Foundry Trade Journal," will assist Mr. McLeod in his secretarial work.

The next meeting of the Section will be held on January 13, 1942, at 5 p.m. at the National Liberal Club, Whitehall Place, London, S.W.1.

Institute of British Foundrymen

London.—Owing to certain difficulties, it has been found impossible to organise a luncheon for early January, whilst dates later in the month clash with the meetings of the General Council at Derby and of the branch. The latter is to take the form of a cinema-talk by Mr. E. M. Currie, director of the International Meehanite Metal Company, on the subject of runners and risers. It will be held at the National Liberal Club at 2.30 p.m. on Saturday, January 31, 1942. Members from the provinces are cordially invited to attend.

West Riding of Yorkshire Branch.—The second of the series of Papers on the "Specimen Casting" was given at a meeting held at the Technical College, Bradford, on Saturday, December 13, 1941, by Mr. James Timbrell, Senr., who dealt with the coremaking section of the series. The sketch and specification of the casting appeared in the FOUNDRY TRADE JOURNAL of November 20.

Concrete Ships

The New York "Journal of Commerce" reports that a new vacuum-dried concrete has been invented by Mr. Karl P. Billner, which can be used in the construction of concrete ships. The inventor claims that hulls of 10,000-ton tankers could be built with the preparation in four weeks or less and still give the ship the same lightness and strength as steel. In a demonstration before the American Society of Mechanical Engineers, Mr. Billner applied a pressure of 12,500 lbs. per sq. in. to a concrete slab 12 ft. long by 2½ in. thick, before it cracked. During the test the specially-prepared slab bent 5 in. in the centre.

B.S.991

(*Concluded from previous page.*)

materials such as low-phosphorus pig-iron, hematite and refined iron, steel scrap and alloys, the consumption of which is necessarily scrutinised by the eagle eyes of the appropriate departments of the control. We can, however, safely assume that given a sufficient degree of priority, the necessary raw materials will be forthcoming for the execution of work connected with the war effort.

We have only one quarrel with the new book and that is the omission of any reference to vitreous enamelling. The surface protection is not invariably added just to communicate a pleasing cleanable finish, but to bestow real engineering properties such as is shown by its use in lining exhaust pipes and tanks for containing corrosive liquors.

Random Shots

With the entry of Japan and America into the present all-in wrestling match, another fond dream, long cherished by British cinema-goers, has been shattered, namely, that Honolulu is a nice place to visit to forget the war with its bombings and its clothes' rationing.

* * *

This, too, is the point at which the devoted philatelist can show his superiority over the ordinary mortal. Whilst other people are poring over maps of the Malay Peninsula and the Pacific Islands, philatelists treat as old friends such names as Kelantan, Kedah, Marshall Islands and Gilbert and Ellice Islands. Some, it is true, have had to take a furtive glance at the map to make sure just where they are placed in relation to each other (and Japan), whilst a few (shame upon them!) have been heard to say, "Well, I've collected Kedah stamps for years, but I'm dashed if I knew where the place was!"

* * *

It is reported that the first black-out to be enforced in Hollywood was not much of a success. This is hardly to be wondered at, for even in this country no one has yet solved the problem of blacking-out the stars.

* * *

The artificial flower trade is said to be booming, because the maintenance cost of real flowers is too high; and already toy manufacturers are getting busy with artificial cats, as they expect it won't be long before people realise that they are the only sort which don't drink milk.

* * *

It was discussion time at a fire-watching lecture, when one bright individual got up to ask the lecturer if it was true that when on fire duty one could take any ladder that was available. On being assured that it was a fire watcher's duty to use any apparatus that was to hand, irrespective of ownership, the Bright One replied: "Good! I've been wanting a ladder for mi'self for a long time."

* * *

A foundry manager recently came into his office smoking a cigar. "What do you think you're doing?" asked his colleague, "smoking the excess profits?" "Good lord, no!" replied the other, "I'm helping the salvage effort. Look how much paper I'm saving by not smoking cigarettes!"

* * *

The Editor tells a good story of his young daughter who was entertaining a newly found friend at home for the first time. The little friend's eye caught a picture on the wall, at which she stopped to gaze with interest. "What church is that?" she asked.

"That's St. Marks in Venice," replied the Young Daughter. "And do you see those horses over the door, just there? They are bronze castings made by a friend of Daddy's called Benvenuto Cellini."

* * *

"Very peculiar times we are living in," comments Grandma. "When men are no longer reserved and women have to divulge their exact age."

* * *

A wag wants to know why military leaders usually "get the sick" instead of "the sack."

* * *

Mrs. Malaprop wants to know if she can have next Thursday afternoon off as she wants to go to a maternity play they are giving at her daughter's school.

"MARKSMAN."

Pattern Equipment for Quantity Production of Small and Medium Castings*

A SURVEY OF MODERN PRACTICE

By F. G. BUTTERS

Introduction

Although much definite progress has been made in the improvement of pattern layout and mounting in recent years, especially by foundries specialising in castings for the motor, electrical, agricultural, and other industries, from the literary standpoint the subject does not appear to have been given the attention it merits, judging by the scarcity of available data dealing exclusively with this highly important phase of modern foundry practice. In the light of this knowledge the object of the Paper is not to introduce any one particular type of pattern equipment, but is an endeavour to survey briefly some of the more popular production methods, the choice of which is governed largely by one or more of the following factors:—(1) Type of moulding machines available; (2) type of pattern equipment, and (3) quantities required and speed of production.

However, before proceeding into technical details, a brief survey of the steady development of present day production methods from those that prevailed in the latter years of the nineteenth century may be appreciated by foundrymen less familiar with quantity production.

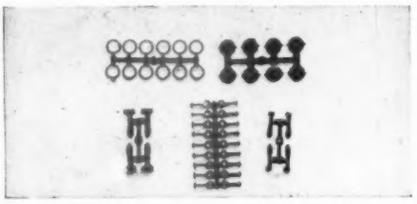


FIG. 1.—SPRAY PATTERNS IN BRASS AND WHITE METAL.

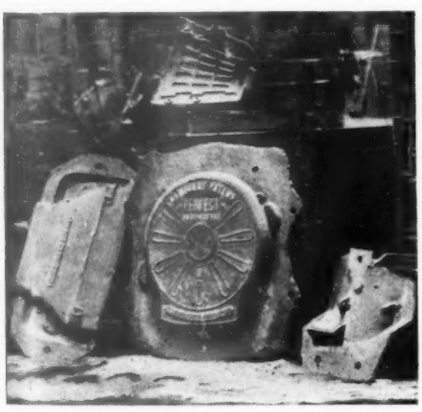


FIG. 4.—PATTERN PLATES WITH IRREGULAR JOINT CONTOUR.

Rolling Over Boards

In the first place, it is fairly obvious that the elimination of jointing was the primary object of the moulder, which, it can be safely assumed, was solved on patterns of simple design, namely by ramming a flatback pattern on a board. No doubt this was soon followed by boards having recesses or holes which would allow projections of patterns to lie in or go through completely, as in the case of the boss of a wheel or other similar projections.

Oddside Moulding

With patterns of irregular contour, the moulder was resourceful enough to observe and appreciate the advantage of an oddside impression, which would in all probability comprise an odd top-part moulding box rammed up with a mixture of sand possessing a good dry bond, so as to permit a reasonable number of moulds to be made from it, the useful life of such an oddside being governed in the first place by the material from which it was made, and secondly by the manner it was treated in service.

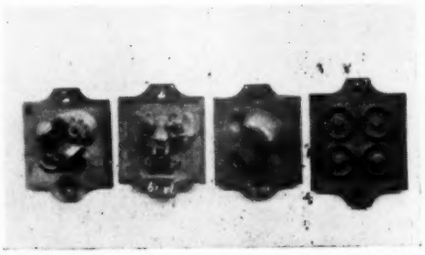


FIG. 2.—SMALL DOUBLE-SIDED ALUMINIUM PATTERN PLATES.

Oddside Composition

Sand, however, as a medium for the construction of permanent oddside impressions had serious limitations, due mainly to its friable nature and especially when being subjected to repeated exposure, together with the consequent wear and tear of normal moulding practice. Efforts to overcome this weakness resulted in the introduction of several mixtures and compounds each more or less successful. Some of the earlier compounds still contained sand as the base material, with additions of vegetable oil, cement, etc., and other binding agents which when dried or baked gave a good hard matrix.

Development in the improvement of oddside and pattern compounds was still the object of further research and experiment, and no doubt was in a large measure responsible for the introduction of plaster of paris and the compound of plaster and cement for this purpose, which incidentally is still used by many foundries at the present time. Certain advantages over this original material have been claimed in recent years by various proprietary brands of pattern compounds. These include such features as smooth surface finish, the ability to reproduce clearly defined contours and impressions, and less liability to develop surface defects or perish after prolonged use.

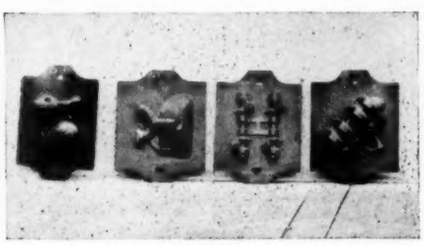


FIG. 4a.—SMALL DOUBLE-SIDED CAST-IRON PATTERN PLATES.

Use of Compounds for Patterns

Although these proprietary materials are used to some extent for oddside impressions, they have a much wider application in the construction of actual pattern plates. This is usually in the form of one half impression in compound, the opposite half being a combination of a metal half-pattern embedded in compound.

In some cases, however, both top and bottom pattern impressions are composed of compound, whilst in others a metal half pattern is embedded in each half impression. Such methods of pattern mounting can be successfully adopted where hand ramming or squeezer type moulding machines are employed, but for use on jolt or jolt-squeeze moulding machines they compare unfavourably with pattern plates of all metal construction, mainly from the standpoint of the lack of physical strength to withstand the severe service conditions imposed on them.

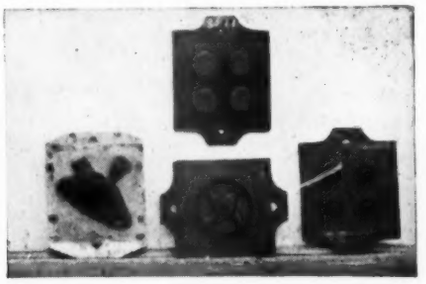


FIG. 3.—PATTERNS MOUNTED ON MACHINED PLATES.

Wood Patterns

Wood patterns have much to commend them, as they can be mounted on wooden boards or metal plates, and can be built up in pine or mahogany, especially the latter, to meet all normal requirements of hand or machine moulding, and can be used successfully on any type of machine. Their choice, however, is governed to some extent by design and the quantity required to be made from them. Economy in weight combined with speed in mounting for production are two distinct advantages of this type of pattern equipment, the former applying of course when manual effort is employed to withdraw same from mould, as in the case of small hand- or pneumatic-squeeze type of moulding. Whilst the advantages of the

FIG. 5.—LARGE PATTERN PLATE OF MOWER FRAME, APPROX. SIZE 5 FT. SQ.

* A Paper read before the East Midlands Branch of the Institute of British Foundrymen, Mr. H. J. Beck presiding.

Pattern Equipment

latter are economy in cost of mounting, together with the saving of time taken to prepare same for production, this being an important factor when speed of delivery of castings is of first consideration.

In certain instances, therefore, wood has definite points in its favour when compared with metal, but its natural disadvantages prove it to be generally unsuitable for the construction of intricate pattern mountings where precision and accuracy of detail are to be maintained during long spells of service.

Warping is a characteristic disadvantage common to this material, and is aggravated more or less by constant contact with damp sand.

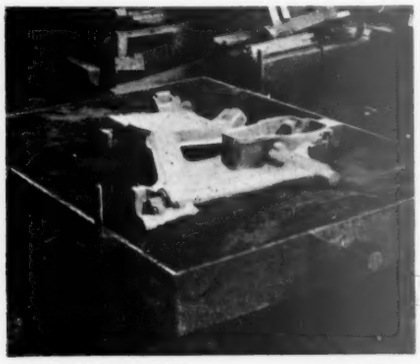


FIG. 6.—WOOD MASTER-PATTERN OF MOWER FRAME, IN POSITION, PRIOR TO RAMMING OF DRAG.

Repeated long exposure to strong sunlight may even be detrimental to patterns of a more fragile nature, whilst its inability to withstand the continuous abrasive action of sand serves to some extent to explain the reason for its rejection in favour of metal for mounting of the majority of patterns for repetition production.

In passing, however, to avoid these remarks being misconstrued, the author would like to explain that it is not intended to discourage or even unduly criticise the practice of mounting wooden patterns, but rather to stress some of the inherent weaknesses encountered, all of which contribute to the limitations of such patterns when severe foundry conditions are fairly considered.

Metals for Pattern Construction

The variety of metals used in pattern construction cover a fairly wide range, including cast iron, brass, white metal, aluminium, etc., each possessing qualities peculiar to their respective character or nature, and which usually determine their selection for the many and varied types of pattern equipment.

Cast Iron

Of the above-mentioned metals, cast iron is the one more generally used, and does with few exceptions possess all the more important qualities necessary for the construction of pattern equipment. Apart from it being the most common of metals, its popularity is further enhanced by its simple manner of working, an advantage not generally shared by the alternative non-ferrous metals. From the standpoint of strength, it compares favourably with other metals, and is capable of taking a fine surface finish. It is also more resistant to the abrasive action of sand, a distinct asset where the continuous production of castings with clean edges is necessary.

Brass

The use of this metal in pattern equipment is largely confined to the actual pattern or section of pattern, the same invariably being mounted on plates of either wood, cast iron, aluminium or steel.

It is also extensively used for the construc-

FIG. 7.—COPE AND DRAG MOULDS FOR MOWER-FRAME PATTERN PLATE, WITH PLATE THICKNESS PARTLY BUILT UP ON JOINT FACE (SEEN IN FOREGROUND).

tion of spray patterns, such as are seen in Fig. 1. Its popularity for this class of pattern equipment is no doubt influenced to some extent by the ease of construction by soldering, but, as will be observed, the size and section of most of these examples are beyond the practical limits of ferrous metals. Its ability to take a fine surface finish excels that of cast iron, whilst its immunity to attack from rust and resistance to effects of chill are advantages not possessed by cast iron. These features prove it to be ideal for the construction of patterns of exceptional light section, whereas in cast iron such patterns would be unmachinable or very difficult to finish by filing.

White Metal

Although this metal is not so widely used for the construction of actual patterns as either cast iron or brass, due probably to its softer nature, and consequent less resistance to abrasive wear, it is invaluable for the lining of intricate stripping plates, this latter application being the means of effecting an appreciable saving in time and labour in pattern mounting.

Two of the main characteristics having a great influence on its selection for this class of work are its low melting point, which is approximately 260 deg. C., and its immunity from the effects of chill, both factors which enable it to be successfully poured into an unlimited variety of intricate shapes and contours. The substitution of lead as an alternative is not generally recommended, owing to its exceptionally soft nature; it can, however, be added to white metal in small proportions to increase its ductility.

Aluminium

Owing to its exceptional lightness this metal has a wide field of application, especially where the fatigue of constant manual effort is taken into consideration, and, like cast iron, can be used exclusively for almost any type of pattern equipment, including flat plates to be machined for mounting purposes; single-sided plates for hand or machine; double-sided plates for hand or machine moulding; or loose patterns for hand moulding. Although, as explained above, the major advantages of this metal are its low ratio of weight to volume, it also shares the advantages of other non-ferrous metals regarding immunity from the effects of rust and chill, and is reasonably resistant to the abrasive action of sand.

FIG. 8.—TOP HALF MOULD FOR MOWER-FRAME PATTERN PLATE.

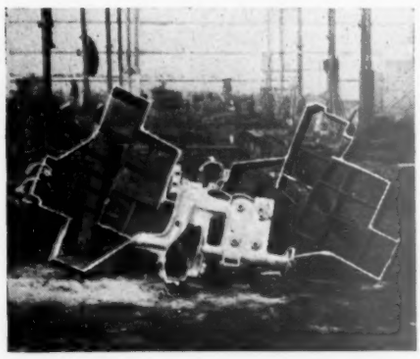


FIG. 9.—PAIR OF MOULDING BOXES AND CASTING OF MOWER FRAME.

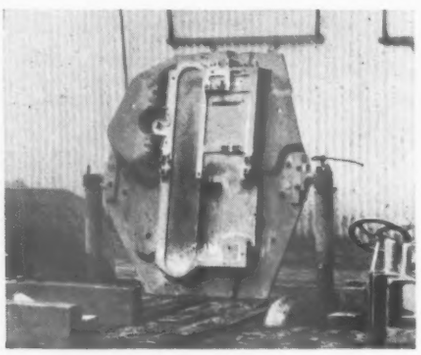


FIG. 10.—LARGE EXAMPLE OF DOUBLE-SIDED PATTERN PLATE, APPROX. SIZE 5 FT. SQ.

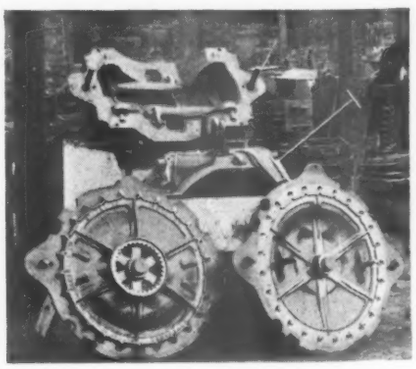


FIG. 11.—PATTERNS PRODUCED BY SPLIT MOULD PROCESS.

Precautions in the working of this metal are necessary to combat the danger of pronounced liquid shrinkage in heavy sections; this in some cases involves a drastic change in the technique of running and feeding, and in some instances necessitates the application of chills or denseners. The pouring temperature should also be carefully controlled, 700 deg. C. being reasonable for small patterns, such as are illustrated in Fig. 2.

Types of Pattern Plates

Pattern plates illustrated in Fig. 3 represent mounting in its simplest form, namely, the split pattern or flatback being mounted on one or

Pattern Equipment

either side of the plate, whilst the group shown in Figs. 4 and 4a are complete double-sided plates in cast iron. As will be observed, the pattern plates in Fig. 4 have joint contours of irregular shape which extend to the outer edges of the plates, and consequently involve the use of special moulding boxes. Obviously, this type of pattern plate has a limited field of application in most foundries; nevertheless, it is a type extensively adopted by stove and grate and agricultural foundries.

An explanation of its popularity for this class of work is due in some measure to the complexity of designs which is encountered, espe-

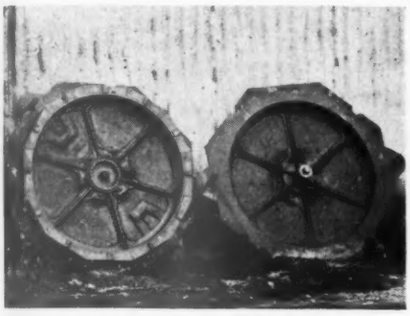


FIG. 12.—PAIR OF PATTERNS FOR TRACTOR WHEELS MADE BY SPLIT MOULD PROCESS.

cially in agricultural foundries, which, if moulded in boxes having straight joint faces, would not only involve the use of a great deal more sand, but would also mean lifting deep cods, both being serious factors when making repetition light castings.

Regarding the size of such pattern plates the useful limit consistent with safety is a rather debatable point, as, obviously, strength cannot be increased by suitable ribs as in the case of a single-sided plate, but can only be attained by increasing thickness.

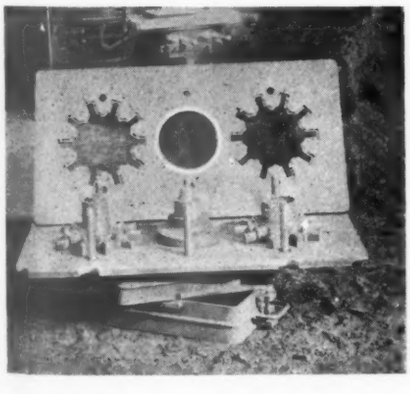


FIG. 13b.—SET OF THREE PATTERN SECTIONS MOUNTED ON BASE PLATE, FOR THE PRODUCTION OF WHEEL HUBS.

The following sections can be safely recommended for cast-iron pattern plates of various sizes:—

Area	10 in. by 10 in. ..	Thickness $\frac{1}{4}$ in.
,,	14 in. by 14 in. ..	,, $\frac{3}{8}$ in.
,,	18 in. by 18 in. ..	,, $\frac{1}{2}$ in.
,,	30 in. by 30 in. ..	,, $\frac{5}{8}$ in.
,,	36 in. by 36 in. ..	,, $\frac{3}{4}$ in.
,,	48 in. by 48 in. ..	,, $\frac{7}{8}$ in.
,,	60 in. by 60 in. ..	,, 1 in.

A pattern of the last size is illustrated in Fig. 5 and, incidentally, this plate is the largest the author had experienced making. Various stages of the moulding of this plate are shown in Figs. 6, 7, 8, and 9. Fig. 10 is also another large example of the 5-ft. square size.

Single-Sided Plates

The adoption of this type of pattern is to some extent influenced by one or both of two principal factors; assuming, of course, that they are to be worked on some type of moulding machine. In the first place, if the moulding equipment is of the pin-lift type, one side of the plate must of necessity be flat and preferably machined. Secondly, if maximum production of moulds is of primary importance machines may be worked in pairs, one producing the cope, the other producing the drag.

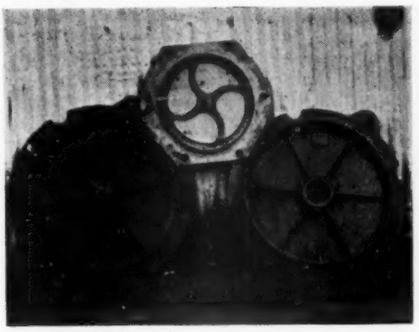


FIG. 13.—GROUP OF CAST-IRON WHEEL PATTERNS MOUNTED ON MACHINED BASE PLATES.

Patterns of this type can be produced by two methods, one by casting a complete pair of plates by the split mould process and the other by mounting patterns or sections of patterns on a machined base-plate. The advantage of the latter method is obviously that of dimensional accuracy, which in many cases is essential where castings must be produced to fine tolerance. It is, however, an expensive method and one which in many cases must rely on big quantity requirements to justify its adoption.

Split Mould Process

This method of pattern plate production is both quicker and less costly and is capable of

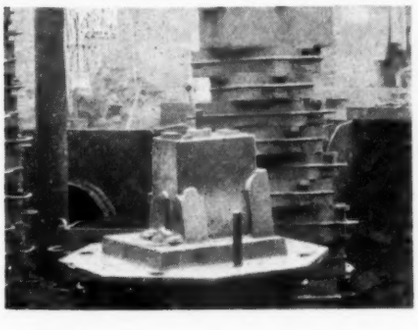


FIG. 13c.—CYLINDER PATTERN OF SMALL PETROL ENGINE MOUNTED ON BASE PLATE.

giving exceptionally good results, subject, of course, to the exercise of extreme care on the part of the moulder. Briefly, the principles of both methods are similar in character, the difference being the substitution of highly skilled craftsmen in moulding for that of the skilled metal pattern fitter.

A group of plates produced by the split mould process is shown in Figs. 11 to 13c. Fig. 12 is an example of the larger types, measuring 42 in. sq., whereas the group in Fig. 13 is mounted in sections on machined base plates, and include such examples as Figs. 13a, 13b, 13c.

Stripping Plates

The use of the stripping plate is not a necessity in every case where it is employed, but it does, without question, simplify the operation of moulding in every instance. Its use is at times almost indispensable where moulding machines are exclusively of the pin-lift type, especially where the patterns are of intricate design. An exception to this rule, however, is illustrated in Fig. 13d.

It is also an important feature in pattern equipment where two or more moulds are rammed simultaneously on pin-lift machines, such as those illustrated in Fig. 14, but could successfully be dispensed with by the introduction of turn-over moulding machines as shown in Fig. 14a. Such, however, is not the case when considering the production of various

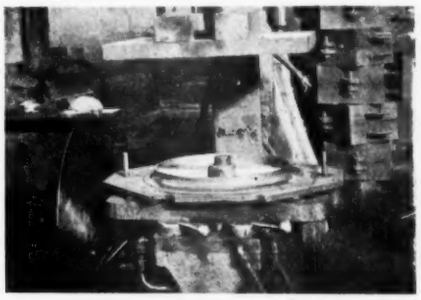


FIG. 13a.—METAL PATTERN MOUNTED ON MACHINED BASE PLATE, FOR THE PRODUCTION OF BOTH COPE AND DRAG MOULDS.

types of gear wheels, including straight, helical and spiral toothed gears similar to those illustrated in Fig. 15.

In each instance the stripping plate is an essential feature, the ordinary spur wheel being a fairly common example involving the simple movement of lowering the pattern through the

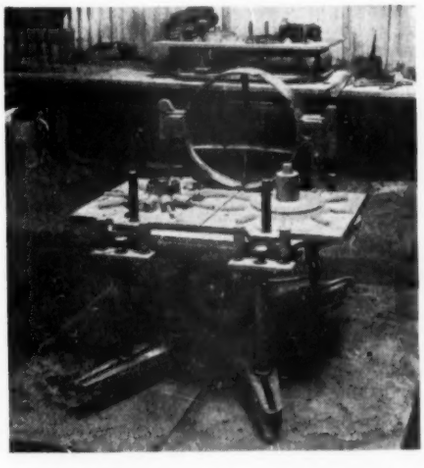


FIG. 13d.—PATTERN LAYOUT FOR PRODUCING COPE AND DRAG MOULDS IN ONE CYCLE OF OPERATIONS, WITHOUT THE USE OF STRIPPING PLATE. ON PIN-LIFT MACHINE.

stripping plate by means of a plunger, but the helical and spiral wheels require different mechanism to actuate their withdrawal. This can be accomplished by two methods, the first being that of mounting the pattern in such a manner which allows it to rotate freely on a centre spindle, the twisting movement necessary on withdrawal being effected by the stripping plate as the pattern is lowered. The second is similar, with one exception; this is in the form of a spring-loaded twisting action of the pattern,

Pattern Equipment

the function of the stripping plate in the latter instance is that of controlling the movement of the pattern during the operation of withdrawal.

Pedal-Operated Stripping Patterns

Fig. 16 is that of a small pedal-operated stripping plate machine designed specially for the production of multiple moulds, a complete set of which is shown in foreground together with a pair of castings. It will be appreciated that patterns of such design can at times present many difficulties when considered from a

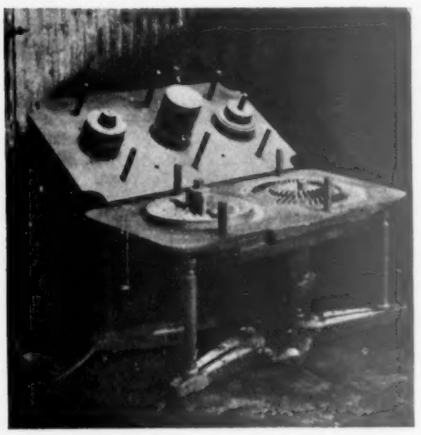


FIG. 14.—STRIPPING-PLATE PATTERN FOR PRODUCING COPE, MIDDLE PART, AND DRAG IN ONE CYCLE OF OPERATIONS.

quantity production standpoint, and may involve a departure from orthodox pattern-making principles.

The earlier patterns of this type were designed for hand moulding, and comprised of four sections, as shown by the example in foreground of photograph; this was necessary in order to facilitate its withdrawal from the mould. Increasing demand, far in excess of hand-moulding possibilities, necessitated a drastic change in moulding methods, which was successfully accomplished by the designing of a simple but very efficient pedal-stripping machine. Its con-

FIG. 16.—GROUP OF PEDAL STRIPPING MACHINES FOR THE PRODUCTION OF MULTIPLE MOULD SECTIONS.

struction consists of a stripping plate bolted to a table, the pattern being held in ramming position by a spring-loaded plunger connected to a foot pedal which, when pressed withdraws the pattern, and when released pushes it back sharply to the ramming position. The reason for the foot operation is to leave both hands of the operator at liberty for ramming, which is done by series of sharp blows by the fists, and the joint face is produced by rotating a small three-armed strickle on a central spindle, the cycle of operations to produce one mould section taking only a few seconds. This example is a typical instance in which the stripping plate is an essential feature of the pattern equipment.

Adaptor Frames

Although pattern plates of the double-sided type are very popular in repetition foundries

FIG. 14a.—PATTERN LAYOUT FOR PRODUCING COPE AND DRAG MOULDS, ON JOLT SQUEEZE TURNOVER MACHINE.

where hand-moulding methods are employed, and in many cases where small squeezing type machines are used, beyond this their limit of usefulness appears to end, especially where the moulding machines are of the joint turnover type. Such, however, is not the case, as these patterns can be used in conjunction with an adaptor frame.

The function of the frame, which must correspond in size to that of the moulding boxes in use on any particular machine, is that of

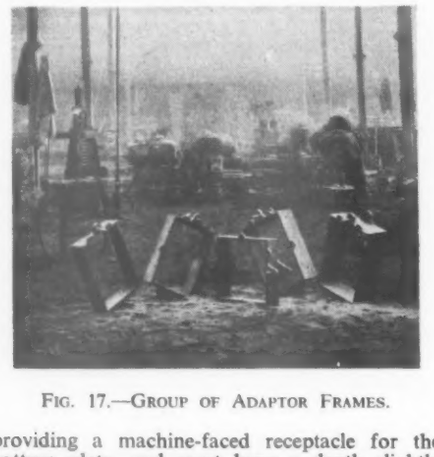


FIG. 17.—GROUP OF ADAPTOR FRAMES.

providing a machine-faced receptacle for the pattern plate, and must have a depth slightly in excess of the deepest pattern likely to be used. This excess in depth is necessary to keep the pattern clear of the jolt table, the frame is designed with eight lugs on the top face and two lugs on the bottom face.

The bottom lugs are at each end of the frame and are used for bolting it to jolt table, those on the top face serve a dual purpose, two of them being in a central position at each end of the frame provide the means of locating the pattern plate, the remaining six being equally disposed round the frame provide effective facilities for bolting down the pattern plate.

An illustration of several sizes of adaptor frames are seen in Fig. 17. Fig. 18 shows an adaptor frame and pattern assembled on the table of a jolt turnover machine.

Patterns Fitted with Down Runners

It may be interesting to note that all pattern plates used on machines of the jolt turnover type are fitted with tapered runner pins, also riser and vent pins where necessary, and each pattern has a special press plate with a clearance hole drilled in a position corresponding to that of the running pin and a small pouring basin fitted to it. The advantage gained by using a special press plate in conjunction with patterns fitted with runner pins results in the production of top part moulds complete with

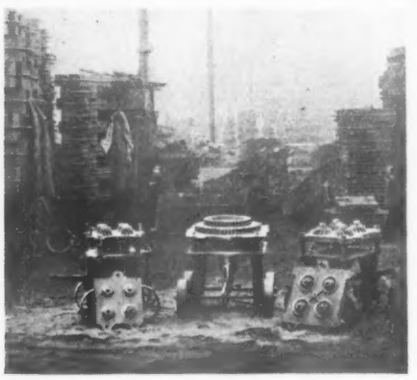


FIG. 15.—GROUP OF STRIPPING PLATE MACHINES FOR PRODUCING STRAIGHT, HELICAL AND SPIRAL GEARWHEELS.

runner and pouring basin in one cycle of operations.

Deep Draw Machines

It must be pointed out that the adaptor frame method requires moulding machines of the deep draw type, this being due to the fact that the

FIG. 18.—ADAPTOR FRAME AND PATTERN PLATE ASSEMBLED ON TURNOVER JOLT MACHINE.

depth of frame reduces the useful distance between jolt table and press head; nevertheless the small extra cost of the machines is more than justified when the substantial economies of pattern-plate production is taken into consideration.

Although the author is fully aware that many more different types of pattern equipment are in general use, some of which possess features peculiar to certain classes of work, by choosing the examples described in this Paper an endeavour has been made to represent a reason-

(*Concluded on page* 396.)

Clay Slurry Additions for Moulding Sand Rebonding*

PROGRESSIVE DEVELOPMENT OF PROCESS AT AN AMERICAN FOUNDRY

By R. H. MOONEY

This is a history of the developments in the methods of making rebond additions to continuous moulding-sand systems in the foundry of the Saginaw Malleable Iron Division, General Motors Corporation, with special emphasis on the clay slurry method as recently developed.

With a mere mention of the old floor sand heaps, which were kept "alive" by the use of naturally-bonded sands, it is proposed to pass to the method of making rebond additions to the first continuous sand preparing system of the middle 20's. With the new continuous system, the improved means of shaking out castings, and also the use of facing sand, reduced the requirements for new naturally-bonded make-up sand to the point where it was necessary to add rebond, in the form of raw clay, directly to the sand system.

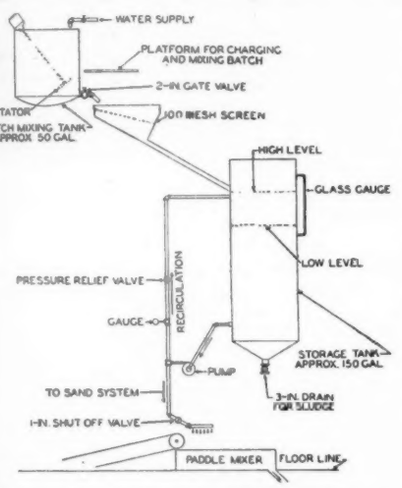


FIG. 1.—LAYOUT OF FIRST SYSTEM INSTALLED TO SUPPLY CLAY SLURRY TO CONTINUOUS MOULDING-SAND UNIT.

At first, this was shovelled slowly into the flow of system sand passing to the preparing unit. However, only a portion of this rebond addition was really effective, as an appreciable percentage of it existed in the form of clay balls. It was then common practice over week-ends to "work" the complete sand system by passing it over special screens at the shake-out as the sand was run through its normal maintenance course.

With the installation of two additional continuous moulding-sand units in the late 20's, the disadvantage of using facing sand with a somewhat rough back-up sand, especially from the mould protection angle, became more and more apparent, and it was decided to eliminate the necessity for facing sand by improving the quality of the complete sand system to the point where it would produce an equal finish on the casting as that obtained with the use of a facing sand. Equipment was provided for the continuous addition of a sand maintenance mixture, and screen equipment was installed to allow screening the sand with $\frac{1}{8}$ by $\frac{3}{4}$ in. mesh as it passed to the paddle mixers. Large, double, sand bins were also installed to allow adequate tempering after the sand from the shake-out was mixed with water and rebond mixture in the paddle mixers.

The rebond mixture used at this time consisted of approximately 10 per cent. clay, 40 per cent. burned sand and 50 per cent. system sand, hauled from the foundry moulding-sand systems, all of which was mixed and mulled for 2 min. in the batch muller formerly used to produce facing sand. Coal-dust additions to the sand systems were also added to this mixture. However, the varying amounts of rebond in proportion to the amount of coal dust required for each of the moulding-sand systems soon resulted in eliminating coal dust from the mixture and adding it separately. It was continually necessary to vary the percentages of clay, burned sand, and system sand in trying to maintain the proper bond strength and the total amount of sand in each system. To obtain anywhere near satisfactory results, it was necessary to have a separate mixture for each moulding sand system.

While the results obtained from the above method were passable, it was felt that much improvement could be made. Over week-ends, it was still necessary to "work" the sand in each system by running it around its normal course as mentioned above, to eliminate some of the clay balls obtained in mixing. The amount of these clay balls would vary as the strength of the mixture was changed. Also, as these balls would absorb much of the moisture added for tempering the sand, a noticeable variance in mouldability of the sand was obtained, even though the moisture content of the sand was maintained fairly uniform. The addition of a rotary paddle revivifier to the system as the sand passed from the tempering bins to the moulders, eliminated some of the clay balls and improved the texture of the moulding sand somewhat. Nevertheless, it was still impossible to maintain the moulding properties of the sand systems anywhere near uniform. Also, the cost of hauling approximately 90 tons of system sand to the mixing shed and the same amount back to the moulding-sand systems was quite appreciable.

First Slurry System Installed

Various types of rebond clays, including some high strength clays, were used, but it was always found economical to revert back to the medium strength clay. From time to time it was felt that if the clay additions required for each moulding-sand system could be suspended in the water used for tempering, all clay balls would be eliminated, resulting in more uniform properties and an improvement in the sand system in general.

Some experiments were conducted to determine the action of the clay on the sand grains by dyeing the clay and studying its relation to the sand under the microscope. Experiments with suspending the clay in small quantities in the laboratory showed that it would stay in suspension for some time, while the 4 to 5 per cent. of sand contained in the clay would settle out quite readily. Therefore, it was decided to experiment in making all clay additions to one of the sand units in the form of a slurry, and a crude arrangement was installed, as shown in Fig. 1.

Operation of Slurry System

The method of operation consisted of preparing batches of clay suspended in water in the mixing tank. This mixture, or clay slurry, was then screened as the batch was transferred to the storage tank to eliminate a larger portion of the sand present in the clay. A centrifugal pump was used to recirculate the slurry in the storage tank and to provide the pressure for adding the slurry to the paddle mixer. Any increase or decrease in clay additions required to the sand system was made by varying the amount of clay in each 50-gall. batch of slurry mixed. About 75 per cent. of the tempering water requirements was used in the clay additions and the other 25 per cent. was added raw by the sand man and varied to maintain the proper moisture content on the sand unit.

This system was operated for about one week, and it was shown that the quantity of clay required to maintain normal bond strength in the system was reduced by some 30 per cent. However, the inconvenience of hoisting the clay up to the batch mixer and the labour required to prepare the batches more than offset the savings in clay. Also, production requirements at that time called for a complete new moulding unit in the near future and retarded any further work in connection with the clay slurry additions.

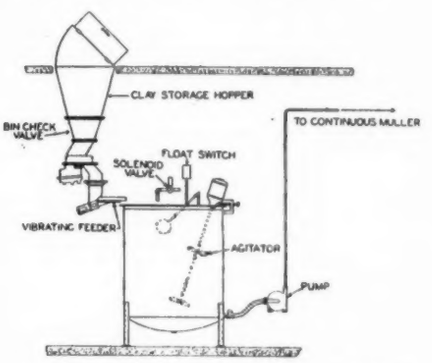


FIG. 2.—LAYOUT OF SECOND SLURRY SYSTEM INSTALLED.

Slurry Operation Discarded

The design of this new moulding unit was an improvement over the existing sand preparing units in that it incorporated a continuous sand muller. Also, provisions were made for separating the shake-out sand from the spill and overflow sand, so that both could be proportionately fed in constant amounts to the continuous muller, along with the dry clay mixture and coal-dust additions. The use of a continuous muller on this new system resulted in a clay saving approximating that formerly obtained when the clay slurry was tried, and nothing further was done with it at that time.

In the meantime, continuous mullers were installed on the other two sand preparing units, reducing the clay consumption on each unit by eliminating the major proportion of clay balls, and improving the quality of the moulding sand in general. With the increasing production requirements of 1939 and 1940, the quantity of dry mixture to be prepared and hauled to and from the foundry was becoming a problem. The time of mixing and mulling each batch had to be shortened to obtain the quantity of dry clay mixture required, and, in general, the condition of the moulding sand was becoming worse.

Improved Slurry System Installed

It then was decided to instal a complete clay slurry system on one sand unit to relieve the

* A Paper presented to the New York Convention of the American Foundrymen's Association. The author is Plant Engineer, Saginaw Malleable Iron Division, General Motors Corporation.

Clay Slurry Additions for Rebonding

immediate demand for dry rebond mixture and determine the advisability of making all rebond additions in this manner, or enlarging the dry mixture preparing unit. Fig. 2 shows the installation as made at that time. The batch mixing and screening operation, as shown in Fig. 1, was eliminated, and the clay fed directly to the storage tank from a hopper at ground-floor level, and filled by dump truck. The initial operation of this unit consisted in trying to feed a constant quantity of slurry to the sand system, varying the strength of the slurry to obtain the desired bond. Raw clay was fed continuously into the tank at a predetermined rate. The water supply to the tank was slightly in excess of that required for the slurry preparation and the tank was kept from overflowing by the float switch.

Difficulties Involved

However, this method did not work so well, as it was impossible to obtain a uniform flow of slurry to the sand system with first a gear pump, then a piston pump and finally a centrifugal pump. The quantity of slurry would vary from time to time, resulting in quite a variance in the bond strength and moisture content of the system sand.

It then was decided to use a centrifugal pump having a capacity somewhat greater than the maximum amount of water required for tempering. The clay was still fed continuously into the slurry tank and varied to obtain the desired bond strength. All tempering water was added directly to the tank causing it to overflow into the larger capacity pump for delivery to the continuous muller. This was a decided improvement over the former method, but it was still impossible to obtain the desired uniformity in bond strength and moisture content, due primarily to the time lag for changes in rate of tempering water additions to take effect at the muller. Also, the flow of slurry to the muller was not uniform, due to a variance in overflow to the pump caused by the violent agitation of the slurry by the motor-driven mixer. Much trouble was experienced by the slurry feed line plugging up, due principally to a settling out of the clay during lunch periods and overnight. Trouble also was experienced by the settling out of the clay in the pump during these idle periods, and with the gradual decrease in pump capacity due to wear caused by the sand content of the clay.

Final Development

In view of the above, it was realised that, while the addition of rebond clay in the form of a slurry was desirable, it would be necessary to obtain a more practical method of transferring the slurry from the mixing tank to the point of addition to the sand systems. It then was decided completely to rebuild the unit as shown in Fig. 3, and install additional units for the remaining two sand systems in the foundry. The clay storage bins were located approximately 30 ft. above the ground and filled with a dump bucket and hoist, operating on a monorail common to the three bins. This arrangement allowed locating the clay slurry mixing and storage tank at a sufficient height above the continuous muller to maintain an 18- to 20-ft. head at the slurry discharge point. The quantity of slurry used is determined by the amount of water required to maintain the desired moisture content of the sand system and is controlled by the system sand man with a plain lug cock carrying a graduated dial.

The motor-driven agitator runs continuously. The water supply to the tank is controlled by the float switch and solenoid valve, and the float is set so that the height of slurry will vary within 8 to 16 in. of the top. The float switch also controls the " on "-" off " operation of the vibrating clay feeder, resulting in the clay being fed into the tank simultaneously with the water each time the float calls for water. The bond strength of the sand system is maintained by varying the rate of raw clay fed into the tank by the vibrating feeder.

Difficulties and their Elimination

The only operating trouble experienced with this apparatus was a plugging up of the slurry line, due to lumps of foreign material, such as coal, stones, etc., becoming lodged at a bend or at the control valve. This was soon eliminated by the installation of a screen inside of the tank at the clay slurry outlet. The tanks are left full overnight and over week-ends, and every three or four weeks are emptied to remove any accumulation of foreign material.

Conclusions

In the normal application of the clay slurry method for rebond additions to the moulding-sand systems, a summation of the results obtained therefrom and conclusions arrived at are as follow: —

(1) In comparison with former practice, the continual handling of sand to and from the sand systems and the mixing of rebond

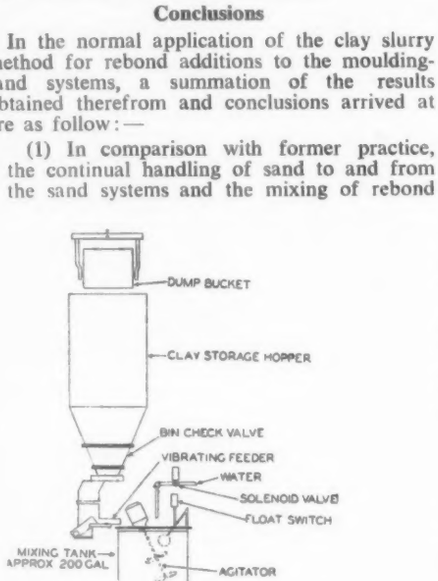


FIG. 3.—FINAL SYSTEM INSTALLED, WHICH OVERCOMES ALL PREVIOUS DIFFICULTIES.

mixtures was eliminated completely. This amounted to approximately 90 tons per day for the three sand systems in a 16-hr. day, whereas, now it is necessary to haul only approximately 13 tons of clay to the sand systems daily, and all cost of mixture preparation is eliminated

(2) Control of the moisture content and bond strength of the moulding-sand systems is definitely more uniform.

(3) The type of clay used was the same as has been used for years past. This clay was a medium priced clay and ground to a fineness whereby approximately 25 per cent. would be retained on a 100-mesh, 25 per cent. on a 200-mesh, and 50 per cent. would pass through a 200-mesh. Trial runs were made with a few of the more expensive higher strength clays which were ground to where 90 per cent. or more would pass through a 200-mesh. However, it was found that the same quantity of these clays was required as the regular clay.

Experiments on Clay Fineness

A trial run on a truck-load of this regular clay ground coarser to where approximately 55 per cent. was retained on a 100-mesh, 25 per cent. on a 200-mesh, and 20 per cent. passing through the 200-mesh, was made. It was found that the same quantity of this coarse ground clay was required to maintain normal system bond as was formerly required when ground to the fineness mentioned above. This was attributed to the montmorillonite characteristics of the clays, the nature of which results in the larger particles being reduced readily to particles of one micron and less when worked with water.[1] All clay now used for rebond on the three sand systems is of the coarser type and is obtained at an appreciable reduction in cost.

It is felt that much more can be done in connection with the use of various clays, or combination of clays in connection with the slurry method of addition to the sand system, and it is now intended to make trial runs along these lines. Some thought also is being given to the addition of coal dust, or a substitute, by the same method, although nothing has been done in this connection as yet.

Pattern Equipment for Quantity Production of Small and Medium Castings

(*Concluded from page* 394.)

able cross section of pattern equipment used in foundries engaged in quantity production of small and medium castings.

In conclusion, the author wishes to express his thanks to the directors of Bamfords, Limited, for permission to use their patterns for the purpose of this Paper, and also to Mr. A. Cotterill who kindly assisted by taking the photographs.

Temperature Measurements in Metallurgy

Ten Papers dealing with temperature measurements of the open-hearth bath, of liquid steel and pig-iron, of the melting point of iron and iron oxide, of red brass during melting and casting, of the specific heat of metals by thermal analysis, of high-temperature liquids by quick immersion, in connection with creep tests, and by pyrometric cones, are contained in a symposium of 125 Papers, entitled: "Temperature: Its Measurement and Control in Science and Industry," recently issued in New York. These Papers were read at a joint meeting in November, 1939, of the American Institute of Physics, National Bureau of Standards and National Research Council.

Republic's Pig-iron Expansion Programme

Republic Steel Corporation is to expand its pig-iron capacity by nearly 1,750,000 tons annually, by the construction of four blast furnaces, 276 by-product coke ovens, increased sintering, concentrating and by-product capacity and expansion of iron ore and coal mining operations. This will increase Republic's blast-furnace capacity by 35 per cent. over the present annual rate of 4,870,000 tons. Two 1,275-ton blast furnaces (combined annual capacity 900,000 tons), equal to Republic's Warren furnace, rated as the world's largest, will be constructed at Warren, along with two batteries of coke ovens each consisting of 75 ovens. At Youngstown the company will build a 1,120-ton blast furnace with an annual capacity of 392,000 tons, while at Gadsden, Ala., an 800-ton furnace will be constructed, annual capacity 280,000 tons, in addition to a battery of 65 coke ovens. These furnaces will account for 1,572,000 tons of the expansion, while the balance will come from the use of high iron content sinter from Port Henry in Mahoning Valley furnaces. At Birmingham, Ala., the concentrating plant will be enlarged and a sintering plant will be erected at the Spaulding ore mine. At Port Henry, New York, a new ore shaft will be sunk, together with hoisting, crushing and concentrating equipment. The concentration plant at Port Henry will have a 1,000,000-ton annual capacity. This programme is the fourth major step taken by the company this year to provide facilities for defence; most of the new facilities will be in operation within the next twelve months.

[1] Grim, R. E., "Elements of Petrographic Study of Bonding Clays and of the Clay Substance of Moulding Sands," Transactions American Foundrymen's Association, Vol. 47, pp. 895-908 (1939).

Rules for the Design of Grey Iron Castings

THE OFFICIAL GERMAN SPECIFICATION

General

1.—The designer should be familiar with general foundry points of view.

2.—The foundryman should always be consulted before proceeding to the new design of difficult castings.

3.—The possibility of mass production should always be borne in mind, even when designing one-off castings.

4.—Large castings of complicated design should preferably be made and assembled from a number of parts, otherwise accuracy of dimensions cannot be ensured.

5.—In particular, small projecting parts, for example bearings, should not be made integral with large castings, but should be fixed on by screws or bolts.

6.—When designing large individual castings, it should be remembered that the mould can be strickled (solids of revolution). This will effect a considerable saving in pattern costs.

Design from the Point of View of Material

7.—Cast iron has a high compressive strength. Its tensile strength and transverse strength are relatively much lower.

8.—The mechanical stresses on individual parts should be prescribed exactly. The choice of strength figures should not, in any circumstances, be left to the foundryman.

9.—The use of chaplets should be avoided wherever possible. This applies more particularly to castings exposed to high internal pressure. Chaplets must definitely be avoided in the case of castings which are to be resistant to high temperature, acid, alkali or sea-water. Cores should therefore be so arranged as to render the use of chaplets unnecessary.

Design from the Point of View of Moulding

10.—In all castings, provision should be made for the possibility of withdrawing the pattern. Taper should be as generous as possible, and should be shown on the drawing.

11.—Undercut portions should be avoided.

12.—Sub-division of the pattern should be single if possible. Avoid multiple subdivisions.

13.—Parts such as lugs, bosses, ribs, fins, etc., if unavoidable, should be fixed firmly to the pattern, so that they can be withdrawn along with it in order to avoid displacement.

14.—Cores should be avoided whenever possible. Ribbed castings are frequently preferable, as they are cheaper to make than hollow castings.

15.—If cores are necessary, provision should be made for:—

(*a*) Rigid support, if possible without the use of chaplets. If necessary, breaks should be provided in the core. These will also act as air vents.

(*b*) Adequate venting.

(*c*) Adequate rigidity by the use of core irons.

(*d*) Possibility of removing the core material and core irons.

16.—Whenever possible, the mutual contacting of a number of cores should be avoided.

17.—As far as possible, cores should be of such a shape that they can be made on a core-moulding machine.

Design from the Point of View of Pouring

18.—Wall thicknesses and cross-sections should be of such dimensions that they can be easily filled by the molten iron.

19.—As far as possible, castings should be so arranged that air can escape upwardly from cavities.

20.—The side of castings which lies on the top in pouring has a greater tendency to porosity and blowhole formation than the bottom side. When pouring, therefore, the side where soundness is of least importance, should be placed uppermost. Caution should be observed in the case of sub-divided patterns and withdrawal tapers.

21.—As far as possible, large surfaces which have to be poured horizontally should be avoided.

22.—Every accumulation of material should be avoided, as it results in shrinkage cavities and stresses. Special attention should be paid to this in the case of machining allowances and ribs.

23.—Abrupt transitions of section should be avoided.

24.—Attention should be paid to shrinkage. Parts of castings should not be so shaped that they can be tensioned or compressed by rigid parts during cooling.

25.—In the case of engine cylinders in particular, the outlet parts should be provided with flat and smooth transitions, and sharp corners and edges should be avoided, since they are liable to cause rupture.

Special Rules for Avoiding Shrinkage Cavities and Stresses

26.—Shrinkage cavities, where unavoidable, should be situated where they are unharmful, that is in pouring gate and feeder heads.

27.—Shrinkage cavities are formed:—

(*a*) In thick cross-sections of castings.

(*b*) When the form of the cross-section is unsatisfactory.

(*c*) At transition places and ribs, where material accumulates.

(*d*) In hubs, lugs and other places where there is a generous allowance of material for the drilling of holes.

28.—Stresses and cracks are produced by uneven cooling, due to uneven cross-sections. Therefore:—

(*a*) The distribution of material and the cross-sections should be such that all parts solidify as evenly as possible.

(*b*) Abrupt transitions should be avoided.

(*c*) Stresses should be equalised by means of curved surfaces and linear boundaries.

29.—In some cases, the foundryman can prevent the formation of shrinkage cavities and stresses by all kinds of devices, but the designer should never rely on this possibility.

(*Continued at foot of next column.*)

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—*Your recent editorial references to the need for co-operation between the designer and the foundryman prompts me to send to you a copy of a specification issued by the German Foundry Owners' Federation in* 1926, *and regarded in that country as a confidential document. If by its translation and publication it reveals any points which have been or are being overlooked by British designers, the trouble I took in bringing it to this country will be well repaid.*

Yours, etc.,
E. H. SALINGER.

London, W.1.

(*Concluded from previous column.*)

Design from the Point of View of Cleaning and Dressing

30.—External and internal surfaces of the casting should be made accessible to fettling tools from all sides. Therefore, particularly in the case of hollow castings, the core openings should be positioned and dimensioned so that the cores can be removed without great difficulty and expense, and the cavities can be properly cleaned.

31.—Pattern and core splitting should be arranged so that the joints lie in one plane. This facilitates removal of burrs formed at the joints, and has a favourable influence on the appearance of the casting.

Submerged Combustion for Pickling Baths*

Submerged combustion heating for pickling baths was the subject of a Paper presented by W. G. SEE to the Association of Iron and Steel Engineers at Cleveland recently.

Eleven years ago the desire for a submerged burner which would be practical for use in pickling prompted a man well versed in steel mill practice to begin experiments with a burner of this type. In order to duplicate the corrosive atmosphere and rough treatment to which pickling equipment is subjected, all test work was done in a pickle room under actual working conditions. From the first experimental burner the results were amazing and proved without a doubt the practicability of equipment of this type. The system comprised a control assembly designed so that the operator or watchman has only to press a button to put the entire unit into operation. The burner is of the nozzle mixing type with no possibility of backfiring.

The burner plate is located beneath the solution level to insure the cooling of the combustion chamber by the surrounding liquid. The tubular combustion chamber conducts the heat and products of combustion down to and across the bottom of the tub, where they are vented and distributed to give the desired agitation.

With submerged combustion, the products of combustion are exhausted directly into the solution. This creates a terrific agitation, and the pickling solution, generally dilute sulphuric acid, is agitated and moved about the vat at a rate which would be extremely difficult to achieve mechanically. As a result the average pickling time on various grades of steel is reduced 40 to 70 per cent. of former practice if the operating temperature is held the same as it was with steam. The agitation also serves to keep the temperature extremely uniform.

Direct firing has other advantages, such as lower pickling temperatures, lower heating costs, more uniform pickling, evaporation of the water from the solution. This latter point is becoming more important with the passage of stream pollution bills. It means less diluted acid to haul away to pits or to reclaim in costly systems. One plant in like production years cut their acid bill from $22,418 to $10,145. Another important advantage is more production with the same pickling-room equipment if handling facilities are adequate or the same production from less tanks. Production increase in one wire department was 296.2 per cent. over open steam-jet heated tanks.

It is extremely difficult to visualise the great agitation created by submerged combustion without seeing a unit in action. It would be equally difficult to believe that an increase of 50 to 80 per cent. in production and a drastically lower pickling cost can be achieved by their use if it were not for the fact that many installations are substantiating these figures in actual practice.

* Iron and Steel Engineer.

Heavy Industries of Japan

THE RAW MATERIALS DILEMMA

Japan, by challenging the democracies to open war in an endeavour to realise her dream of an East Asian Prosperity Sphere under Japanese dictatorship, calls renewed attention to her questionable capacity to maintain for any length of time a powerful war machine in the field by the supply of an adequate quantity of armaments and munitions from her heavy industries. Her infant industrial structure is of a bare four decades growth, raised on a very restricted raw materials basis with a heavy dependence on external sources of supply. Efforts have been made in recent years to alleviate this position, by developing the industrial potential of conquered and occupied territories, but the success in this direction has only been moderate. Thus the Manchurian aggression was prompted by the need for an extended coal and iron ore basis. Her present adventure is also partly designed to extend her raw-materials bases, particularly in Malaya, China and the Pacific.

Iron and Steel

Unlike the other belligerents of the present war, Japan has chosen a moment to enter the struggle when her iron and steel output and raw-materials bases had passed their zenith, and serious problems had already for some time been exercising her industrialists in the provision of sufficient raw materials to maintain and expand her iron and steel production. Up to the outbreak of the European war in September, 1939, Japan had experienced no difficulty in obtaining the raw materials, especially scrap, needed for her iron and steel industry, almost wholly from abroad. The European war brought increasing stringencies in supplies, and eventually, with the banning of scrap exports from the United States, conditions of supply became very parlous. Within the last two years every possible endeavour has been made to create and develop alternative and more dependable sources of supply to those on which the industry had been built up. The position was further aggravated by the imposition of economic sanctions last July.

This state of affairs is a direct consequence of Japan's poverty in raw materials of any value and her comparative brief period of industrialisation on a very insecure basis; it is reflected by the following figures for 1935, which is the latest year for which full details are available: Iron ore output in 1935 was 2,592,000 metric tons, of which 516,000 tons were mined in Japan Proper, 598,000 tons in Korea and 1,478,000 tons in Manchuria. In addition, 3,334,000 tons of foreign ore was imported, as well as 1,692,000 tons of scrap, while domestic scrap contributed 1,430,000 tons. Output of pig-iron in 1935 was 2,760,000 tons, of which nearly 2,000,000 tons were produced in Japan Proper; production of steel ingots was 4,596,000 tons, nearly all open-hearth steel. According to Japanese returns, the percentage of scrap used in steelmaking was 63.5 per cent., an increasing quantity of which had been covered from outside sources. Finished steel output was 3,677,000 tons in 1935, the principal products being plates (1,178,000 tons), bars (927,000 tons), shapes (482,000 tons), wire rods (408,000 tons), and rails (377,000 tons). In the same year pig-iron and ferro-alloy imports were 960,200 tons, and those of finished steel 316,710 tons.

The position in 1935 was, therefore, that nearly 47 per cent. of the raw materials of the iron and steel industry had to come from abroad (taking the absolute values of iron ore, pig-iron, ferro-alloys and scrap from foreign and domestic sources), while finished steel imports were only 8.64 per cent. of domestic output. In the last twenty years the home industry has brought about a shift in finished-products supply from a bare 40 per cent. in 1922 to over 90 per cent. in 1935 and following years, the balance being supplied by imports. But this change has not been achieved by a corresponding betterment in raw-materials bases, for while steel output has multiplied just over six times from 1921 to 1936, and finished steel output nearly seven times, the output of iron ore has gone up barely five times, ore imports 4½ times, and scrap imports no less than twentyfold.

Steel Scrap Imports

Japan's difficulties as regards raw materials started when war broke out in Europe and the United States became war-conscious. Supplies were immediately curtailed, without alternative sources being forthcoming. The shortage of scrap supplies from the United States from mid-1940 onward, after imports from this source had already been contracting for some time—1937 and 1938 imports having been around 2,000,000 tons and in 1939 only 1,500,000 tons—caused a strict control to be exercised on scrap consumption and increased activities in the accumulation of domestic scrap, but without the gap being bridged. The proportion of scrap in steel furnace charges was fixed at a lower level during 1940 by the Japan Steel Materials Federation, and further attention given to the exploitation of low-grade Japanese ores, mainly by the Krupp Rennverfahren. Progress has been slow and no appreciable improvement in the position had been realised by the autumn of this year. The Mitsubishi concern carried out extensive work with the Krupp method of treating low-grade ores, as well as seven other concerns, but all reported that the process was very costly and would require radical alteration before being completely suitable for Japanese purposes. Iron ore was sought from new sources, particularly India and Australia (Yampi Sound), but only small quantities of ore were forthcoming, especially in view of the action of the Australian Government to conserve Commonwealth ore resources for its own use, preventing extensive exploitation and domination by the Japanese.

Alloy Supplies

Japan's poverty in alloying elements has also been a source of great concern, as these came largely from other possessions in the Pacific area. As in Germany, attempts were made to find a substitute for nickel, supplies of ferro-nickel being prohibited to certain consumers to conserve the metal, and experiments made on the extraction of vanadium from vanadium sands. The alloy-steels situation became precarious in 1940, with no improvement in 1941; supplies had become seriously cut down and costs of production had advanced without a corresponding increase being made in selling prices owing to the strict price control being exercised. All nickel, vanadium and cobalt required has had to be imported, while home supplies of tungsten, molybdenum and titanium are strictly limited. The Thai surrender has eased the situation slightly in tin, but metals for steel alloys have not benefited.

With the difficulties in obtaining raw materials for the iron and steel industry, which have been intensified during the past two years, it is probable that the Japanese metallurgical industry has passed a peak of production, and that with practically all overseas sources of supply closed, the situation has become much worsened. For some time operations have been carried on by drawing on existing stocks —which, it is true, have been built up to considerable dimensions in the last few years—but it would be surprising if these are exceptionally large in view of the heavy dependence of the industry on such supplies and the small yield which has accrued in the search for alternative sources. Japanese industrialists cannot look with equanimity on a long war with no long-term potential worth mentioning to fall back on.

Expansion of Industry

The extent and growth of the Japanese metallurgical industries may be gauged from the fact that between 1929 and 1936 the value of the output of the iron and steel and mechanical-engineering industries increased from 18 to 30 per cent. of total industrial output, and in 1936 reached 3,760 million yen. The chief reason for this rapid expansion was due to the State taking over the Yawata Iron and Steel Works in 1934, whose 1936 capacity was equal to 67 per cent. of Japanese pig-iron output and 40 per cent. of steel output. In the same period of seven years, considerable capital investments were made in the heavy metallurgical industries, and the number of actual undertakings in iron and steel and mechanical engineering increased from 2,436 in 1929 to 6,432 in 1936. Capital and reserves increased from 1,195 to 2,512 million yen, while net profits were returned at 230 million in 1936 as against only 42 million in 1929.

Much of the steel plant is of modern design and many extensions and improvements have been made in recent years. In 1939, for example, extensive new equipment was ordered from American manufacturers, including an 86-in. semi-continuous

(*Continued in last column.*)

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

538,364 BUDD INDUCTION HEATING, INC. Quenching method and apparatus.

538,384 BRITISH ROPES, LIMITED, and GIBSON, A. Steel wire ropes.

538,439 UDY, M. J. Exothermic mixtures for use in the production of iron and iron alloys, and method of using such mixtures.

538,445 GASCOIGNE, G. H., and KNOX, J. R. Tube-cutting machines.

538,477 UDY, M. J. Chromium metallurgy.

538,483 MORTON, JUN., B. Clothing or encasing of girders, beams, stanchions, and the like.

538,512 STEVENS, A. H. (Aluminium Company of America). Moulds for casting purposes.

538,569 LINDE AIR PRODUCTS COMPANY. Methods and apparatus for the removal of scale from the surface of metal bodies.

538,595 BRIDGES, W., and CHAMBERS, A. J. Process of hardening and tempering armour-piercing projectiles.

538,596 BRIDGES, W., and CHAMBERS, A. J. Apparatus employed in the hardening and tempering of projectiles.

538,615 DOW CHEMICAL COMPANY. Electroplating metals.

538,616 DOW CHEMICAL COMPANY. Electroplating magnesium and alloys thereof.

538,636 BRIDGES, W., and CHAMBERS, A. J. Apparatus employed in the heat-treatment of projectiles and other metal articles.

538,637 SCHMELLER, E. A., SCHMELLER, SEN., J., SCHMELLER, F. L., and SCHMELLER, J. L. Aluminium alloys.

538,677 CELIC CORPORATION, LIMITED, and TOWNSEND, C. S. Solution for preventing boiler incrustation and the elimination of rust and corrosion, and a method of preparing the same.

538,721 BRITISH THOMSON-HOUSTON COMPANY, LIMITED. Hard alloys.

538,745 REDLER, A. Conveyors for granular and powdery material.

538,803 WELLMAN COMPANY, S. K. Method of and apparatus for spreading powdered material in a mould.

538,805 WEAN, R. J., and THEISS, H. W. Method and apparatus for coating metals by dipping.

538,858 LINDEMUTH, L. B. Regenerative open-hearth steel furnaces.

538,867 STEVENS, A. H. (Aluminium Company of America). Casting of pistons and similar cup-shaped articles.

538,886 CONSOLIDATED MINING & SMELTING COMPANY OF CANADA, LIMITED. Preparation of substantially sulphur-free manganese alloys.

539,006 WHITE, C. B. Process for recovery of metals from alloys and metallurgical residues.

539,023 MAGNESIUM ELEKTRON, LIMITED, LEECH, H. R., and LEWIS, G. J. Fluxes for use in the treatment of light metal.

539,043 WHESSOE FOUNDRY & ENGINEERING COMPANY, LIMITED, and TAYLOR, A. E. Cleaning of gases.

539,046 ATKINSON, J. S., and STEIN & ATKINSON, LIMITED. Covers for soaking-pits and the like.

539,129 LEHMANN, H. L., and SONDHEIMER, A. Composition of hard metal carbide alloys.

539,144 VEREINIGTE HUTTENWERKE BURBACH-EICH-DUDELINGEN AKT.-GES., and WAGENER, A. Process for obtaining iron from the slags produced in the soda desulphurisation of pig-iron.

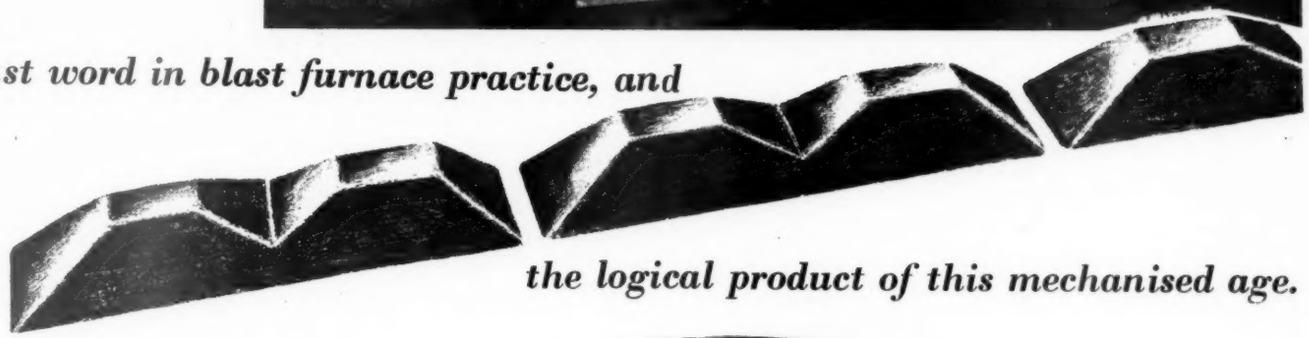
539,166 THORNTON, A. A. (Cleveland Graphite Bronze Company). Method of tin-coating ferrous metals.

(*Concluded from previous column.*)

plate mill and a modern sheet mill. These were to be installed at once and were expected to be in operation at the end of this year. What progress has been made with these and with much of the other new plant on order, it is difficult to say. Every attempt was, however, being made to expand the Japanese steel industry on approved American and European lines, so as to achieve maximum output and its corollary maximum independence of foreign supplies.

STANTON

Last word in blast furnace practice, and



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THERE ARE NO SOWS

THERE IS A NEW MODERN SHAPE

designed to facilitate stacking

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THE STANTON IRONWORKS COMPANY LIMITED, Near NOTTINGHAM

The Week's News in Brief

Trade Talk

A NEW CANTEEN which has been opened at the works of the Brush Electrical Engineering Company, Limited, can accommodate more than 1,200 people at one sitting.

NOTICE IS GIVEN of an intended dividend by Wembley Aluminium, Limited, Wembley Hill Estate, Wembley, Middlesex. The last day for receiving proofs is December 20.

ABERDARE CABLES, LIMITED, have purchased the assets of Whitehead Switchgear & Inventions, Limited, of Treforest, and propose carrying on the business by means of a subsidiary company—South Wales Switchgear, Limited.

THE EXISTING CONTROL of diamond dies has been enlarged to include diamond tools, and the Minister of Supply has appointed Mr. R. L. Prain, Deputy-Controller of Diamond Dies, to be Controller of Diamond Dies and Tools.

A REQUEST that the Government should amend the Essential Work Order so as to provide for penalties being imposed on employers as well as employees has been forwarded to the National Executive by the Confederation of Engineering and Shipbuilding Unions in the Clyde area.

ACCORDING TO the Ministry of Labour and National Service, the number of men and boys registered at employment exchanges in Great Britain as wholly unemployed on November 17 was 95,335, a decrease of 1,699 compared with October 13. Of this total 27,821 had been classified by interviewing panels as unsuitable for ordinary industrial employment.

UNDER THE TERMS of Board of Trade Orders which came into force with immediate effect, all export and transhipment licences for goods consigned to any of the following destinations have been revoked:—Japan (including Karafuto), Chosen (Korea), Manchuria, Kwangtung Leased Territory, Taiwan (Formosa), Japanese Mandated Islands, Japanese Islands, China (except via the Burma Road), Macao, Portuguese Timor, Thailand, French Indo-China.

THE CLAIM FOR AN INCREASE of £1 a week for time workers in the engineering industry and a comparable increase for piece workers, presented by the Engineering Joint Trades Movement on behalf of 40 craft unions and two general labourers' unions, was heard in private by the National Arbitration Tribunal last Friday week. On the following Monday there was a public hearing of the claim of the Amalgamated Engineering Union for an advance of 4d. an hour. Mr. J. Tanner, President of the Amalgamated Engineering Union, appeared before the Tribunal to argue the claim of the A.E.U. and the National Union of Foundry Workers. He asserted that the wage rates of fitters and turners in many districts were below £4 a week and that engineers' actual pay packets showed a picture very different from the one popularly presented. Sir Alexander Ramsay, replying for the Engineering Employers' Federation, praised the splendid service of the workers. He refuted the argument that the employers were getting something out of this war, in the way of excessive profits, which the workers were not. The employers had taken the line of rejecting the claim not with the slightest desire to come into conflict with their workpeople, but because there were times when a responsible organisation had to face its responsibilities. The Tribunal will issue its award in due course.

SIR PATRICK HANNON, M.P., President of the National Union of Manufacturers, speaking at the annual meeting of the Union recently, said that the task with which industry would be faced after the war was one of great magnitude and complexity. Not the least important matter would be the release of industry from the concentration imposed upon it by war necessity. It might be safely assumed that competition in world markets would present altogether new features in the days of peace. The plain fact was that industries which had become interdependent in wartime must continue so afterwards. In the sphere of international trade the exchange of commodities would probably take the form of operations by groups or blocks of industries rather than by individual enterprise, each fighting for its own life. The creation of a vast array of secondary industries in the British Commonwealth indicated also the limitations of export vitality in the Dominions and the Colonial Empire. Canada, for example, had concluded most-favoured-nation trade agreements with most of the South American republics. Canadian leaders of industry visualised a large expansion of trade with Latin America. These facts must be noted by British industrialists as an indication of the extent to which markets hitherto open to Great Britain would become much more difficult of access.

A CENSUS OF EARNINGS at 56,600 establishments was taken last July by the Ministry of Labour and National Service. The returns included all wage-earners, but excluded the salaried staffs. Wide variations of increase between different industries were disclosed. Increases since October, 1938, when a similar census was taken, ranged from about 18 per cent. in the paper and printing group and 20 per cent. in public utility services to 48 per cent. in the building and contracting industries and 49 per cent. in the metal, engineering, and shipbuilding industries. In general engineering last July the average of men's earnings was 106s. 8d.; of youths' and boys' 40s. 4d.; of women's 50s. 7d.; and of girls' 29s.; and they were respectively 44.8 per cent., 65.8 per cent., 57.7 per cent., and 48.7 per cent. above the earnings in October, 1938. In the motor-vehicle and aircraft manufacturing sections of the engineering industry men's average earnings were 127s. 5d., youths' and boys' 48s. 5d., women's 54s. 9d., and girls' 33s. 6d.; the increases on those of October, 1938, being 53.4 per cent., 71.4 per cent., 36.6 per cent., and 26 per cent. In shipbuilding and ship-repairing men's earnings were 116s. 7d., and youths' and boys' 37s. 10d.; the percentage increases on October, 1938, being 66.3 per cent. and 82.3 per cent.

Obituary

MR. JOHN MASON, retired engineer, for many years with P. & W. Maclellan, Limited, Clutha Works, died in Glasgow on December 7.

MR. OSCAR DEUTSCH, the cinema proprietor, who died on December 5 at the age of 48, commenced his business career in his father's non-ferrous metal business in Birmingham, and he maintained his interest in the concern until his death.

MR. A. C. MCCOLM, Deputy Director of War Supplies in South Africa, died recently. Mr. McColm was closely associated with the development of the electrical and steel industries in South Africa, first as commercial manager of the Electricity Supply Commission and later as commercial manager, then general manager of the South African Iron & Steel Industrial Corporation.

Personal

MR. A. J. PEECH has relinquished his position as secretary of the Stanton Ironworks Company, Limited, in order to take up his appointment as a director of the United Steel Companies, Limited, from December 1.

MR. ROGER DUNCALFE, president of the Association of British Chemical Manufacturers, has been appointed chairman of the Chemical Divisional Council of the British Standards Institution in succession to Dr. E. F. Armstrong.

MR. V. W. BONE has been appointed chairman, and MR. F. N. LLOYD managing director, of F. H. Lloyd & Company, Limited, steelfounders, Wednesbury, to fill the place of the late Mr. F. J. Hemming, chairman and managing director.

MR. AMBROSE FIRTH has been appointed chairman of the Brightside Foundry & Engineering Company, Limited. MR. T. C. FIRTH has been appointed general manager of the foundry and engineering department and MR. C. P. HOW as general manager of the heating department.

MR. R. O. HERFORD has been appointed by Lord Beaverbrook to be Controller of Inspection (Administration) in the Ministry of Supply. Mr. Herford was general works manager and director of the Renold & Coventry Chain Company, Limited, and has been released by the board of that company to take up his new post.

Reports and Dividends

Hepworth & Grandage—Interim dividend of 7½%.

F. H. Lloyd & Company—Interim dividend of 3% (same).

Gascoignes (Reading)—Net trading profit to October 31, £610,422 (£820,930); interim dividends, (12½%).

Birmingham Small Arms—Annual meeting convened for December 16 will be formal, as the accounts are not yet ready for presentation.

Atlas Steel Foundry & Engineering—Profit for the year ended September 30, £29,232 (£38,107); depreciation account, £5,000; interim dividend of 15% (same), £8,437; final dividend of 17½% and bonus of 10% (same), £15,469; forward, £4,624 (£4,298).

Imperial Smelting Corporation—Income from subsidiaries, £285,682; other interest and dividends, £13,160, making £298,842 (£280,640); directors' fees, £11,354 (£12,175); E.P.T., £48,500 (nil); net balance, £238,988 (£268,465); preference dividend, £134,538; ordinary dividend of 4%, £101,498 (3½%, £88,811); forward, £53,871 (£50,919).

Crittall Manufacturing—Profit for year to August 31, 1941, after income-tax, N.D.C. and £48,500 (£35,665) for depreciation, £264,435 (£207,040); leasehold depreciation and amortisation, £48,500 (£35,665); to debenture redemption reserve, £8,252 (£8,895); to contingency account, £15,000 (£10,000); to reserve for future taxation, £15,000 (£10,000); A.R.P., £17,025 (£10,000); ordinary dividend of 15% (5%); forward, £38,236 (£37,905).

New Companies

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Sincromo Engineering, 90, Queen Street, London, E.C.4—£2,000.

Coldbath Foundry, 151, Englefield Road, London, N.1—£1,500. P. E. and B. D. Croxford, and A. C. and E. M. Lester.

Tungsten Distributors—£10,000. C. A. Barry and J. Ismay. E. G. Scott, 31-2, New Broad Street Avenue, London, E.C.2, subscriber.

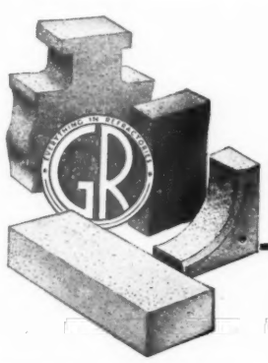
Cast Iron Heating, Boiler & Radiator Manufacturers' Association (company limited by guarantee Beeston Boiler Company, Limited, Mona Street, Beeston, Notts; Crane, Limited, Hartley & Sugden, without share capital)—To protect the interests of cast-iron boiler and radiator manufacturers. Council to be nominated by the subscribers, who are:—Limited, Ideal Boilers & Radiators, Limited, and Lumleys, Limited.

Shortage of Professional Engineers

The Institutions of Mechanical and Electrical Engineers are co-operating with a committee set up by the Minister of Labour, under the chairmanship of Lord Hankey, in an effort to remedy the growing shortage of professional engineers for the Services, the Supply Departments and industry. Immediate steps to be taken to help remedy this serious shortage are:—(1) Suitable men from industry who were under 25 when they registered for military service will be considered for technical commissions to the services; (2) youths of a certain educational standard withdrawn from industry will be rendered suitable for up-grading by these intensive courses, and will for the most part return to industry. In the first case, the views of the employers of the men selected will be taken into account by a Central Allocation Committee in the Ministry of Labour, on which the Supply Departments will be represented. All holders of University degrees or Higher National Certificates in Engineering in this age group are affected by this decision, whatever their present occupation, according to the schedule of reserved occupations. Men who undertake the intensive training will be given six months' technical training at State expense. The effect of this will be to bring them to much earlier technical maturity. As the war goes on, other intensive training schemes will have to be put into operation. Parents with sons of secondary school education are asked to consider placing them in these callings. Engineering employers are to be encouraged to give leave of absence in order that men can undertake the training course. Industry will also be asked to supply trained men to assist as part-time instructors.

... BEGINS AND ENDS WITH REFRACTORIES

THE WHIRR of an alarm clock, a smooth shave, the rumble of a train or the swish of a car are a few commonplace occurances which should remind men that all the productions of the modern world are the creations of HEAT—harnessed and controlled by Refractories. Naturally the selection of suitable refractories is important because refractories decide the life as well as the output or efficiency of all industrial furnaces. Wherever plates and sections, castings and forgings, power and light are produced or generated: in iron, steel and alloy plants, in the glass and ceramic trades: in the cement and chemical industries: wherever men use Heat—there you will find General Refractories products.



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Raw Material Markets

Iron and steel manufacturers have for a long time past been operating their plants solely in the interests of the war effort, and under official guidance; so that the crisis engendered by the entry of Japan into the conflict will not mean any immediate quickening of activity by the iron and steel industries, although they may be relied upon to seize any opportunity to expand production that may present itself. The Iron and Steel Control, with the co-operation of producers, have harnessed iron and steel production as fully as possible to the requirements of the war machine, so that the new situation is unlikely to be followed by any material changes in methods of distribution. Many new munition works have been started up during this year, while it is to be expected that 1942 will witness much further expansion in this direction, and it is confidently anticipated that the iron and steel industries will be able to keep pace with the rising demands on their facilities. Imports from the United States have been curtailed during the past few months, and now that America has been brought into the war by Axis intrigue, it is possible that deliveries to the United Kingdom will be further reduced, at least for the time being. Comparison between United States and Japanese iron and steel outputs is very favourable to our new Ally, and may well be a big factor in the final outcome of the conflagration.

Pig-Iron

MIDDLESBROUGH—A fair amount of business in foundry iron has already been negotiated for the first quarter of next year. Furnaces in the Midlands are well placed to cope with the demand emanating from consumers on the North-East Coast, who are able to buy in excess of their immediate requirements. Hematite supplies are distributed very sparingly, available tonnages being held by the Control, who will only release deliveries in exceptional instances, such as when a consumer is engaged upon work of high priority and cannot obtain satisfactory results by the use of alternative grades of iron. This policy has resulted in considerable stocks of hematite being accumulated in the hands of the Control. Refined iron is forthcoming satisfactorily and is in strong request.

LANCASHIRE—Derbyshire and Staffordshire makers of common foundry iron could easily despatch larger tonnages than are at present being requisitioned by users in the Lancashire area. There has, if anything, been a slight upward movement in the demand during the past few days, due to some jobbing foundries having a little more work on their books, but this may be only temporary, as there is no indication that these foundries will be able to acquire much business to bring about any permanent change in their operations. Demand from the light-castings branch also is only moderate, with prospects for the New Year anything but happy. Speciality engineering establishments, including machine-tool makers and electrical engineers, continue to be busy and their pig-iron requirements amount to a substantial tonnage. Most works in these categories are doing a large volume of business with Government departments, so that they may look forward to full-scale production during the coming year.

MIDLANDS—Foundries producing light castings are still not called upon to furnish much material to the war factories, and as their ordinary trade has largely vanished, they cannot maintain full-scale operations. It is somewhat ironical that they may acquire more than they need in the matter of iron, ample supplies of high-phosphorus material being at their disposal. The iron requirements of heavy engineers, who have very extensive commitments, on the other hand, are a much more difficult problem. Moderate tonnages of low- and medium-phosphorus grades are available, but hematite is unobtainable except in special circumstances. These consumers are utilising refined and high-phosphorus irons, together with cast-iron and steel scrap, to the fullest possible extent, and are securing satisfactory results.

SCOTLAND—As had been anticipated, deliveries of foundry iron have quickened, and further improvement may confidently be expected. Consumption among the marine and heavy engineering establishments generally is very substantial, as these works have a large volume of Government and other important business on their books; in fact, very few of them are in a position to accept fresh commitments from other sources, as replacement orders in connection with the war effort are continually coming to hand. Unfortunately, there is still a considerable proportion of idle plant at many of the light-casting foundries, and the prospects of improvement in the New Year are slight. It is greatly to be hoped that some useful work will be found for this branch of engineering, but the present amount of Government business is negligible. Makers of light castings can get all the high-phosphorus iron they require from the English Midlands, and many have taken advantage of the easy supply position to augment their stocks.

Coke

With many consumers stocked to the limits of their storage accommodation, supplies of foundry coke are assured over some time to come, as the ovens continue to despatch deliveries fully and promptly, and the current output is well able to look after all requirements. For delivery to Birmingham and Black Country stations, the price of Durham best foundry fuel is 62s. 9d. per ton.

Steel

The chief preoccupation of the steel industry at the present time is with alloy steels, and very appreciable tonnages are continually being taken up for the production of munitions, etc., for which these qualities are eminently suited. While still bigger quantities are needed, development in production has been outstanding, and plans for 1942, if they can be attained, should result in considerably increased deliveries to consuming points. Makers of structural steel are slightly more active, and there are prospects of additional requisitions being made on behalf of the Government. If these mature they will enable producers to increase the rate of operations, which have fallen away recently. Plate mills are very briskly employed, and a large proportion of their output is being absorbed in the shipyards. Delivery periods are satisfactory in most instances. The lighter sections of the steel trade are, on the whole, only moderately engaged, but some works have a fair amount of urgent business on their books.

Scrap

Attempts have been made in recent months to reduce the reliance of British scrap iron and steel users on metal imported from the United States, and much success has attended these efforts. We had not the shipping space to spare for such bulky cargoes as scrap metal, while another motive was the exchange factor. Now that the United States is an active partner in the struggle of the democracies, that country will be less inclined to export scrap, and our policy of using home-produced metal has been justified. There are considerable stocks on hand, but now, more than ever, we shall have to lose no opportunity to seek additional supplies, not only to satisfy present demands, but also to meet the larger needs which will inevitably be the outcome of next year's plans for the expansion of munitions production.

The Ministry of Supply on Monday made an urgent call for more scrap metal for war industries. Compulsory powers will probably be taken to enable the Ministry of Works and Buildings, which collects on behalf of the Ministry of Supply, to schedule unnecessary railings for removal. The same Ministry will also be empowered to take other kinds of scrap, such as obsolete plant and machinery, which are the subject of a national survey now in progress. This survey, hitherto undertaken by local authorities, will be completed by the Ministry of Works and Buildings. To help in the survey a staff of men and women is being recruited who will tour the country to seek untapped reserves of steel and iron. Steel from bombed buildings is rapidly giving out as a source of scrap; some 250,000 tons have been recovered since the beginning of July.

Metals

TIN—Dealings in tin on the London Metal Exchange are still suspended and the market remains under the control of the Ministry of Supply. Last week a deputation from the Exchange submitted proposals for allowing open dealings on the Exchange within a certain range of prices, but on Thursday last it was announced that while the representations made by the deputation had been fully and sympathetically considered, the Ministry regretted that in all the circumstances they were unable to agree to the resumption of dealings in tin on the Metal Exchange. The Ministry of Supply also informed the Exchange that they would not object to merchants delivering to consumers tin which might be urgently required against outstanding pre-Control contracts, providing consumers previously obtained licences from the Control. Proposals have now been submitted to the Exchange by the Ministry, and these are now under consideration.

It was announced from Singapore on Friday that the Government had under consideration a scheme for financing tin production by a system of advances against deliveries in the event of "no market" conditions continuing for any length of time. Tin-producing areas in the East continue to be heavily attacked by Japanese forces, and the position in Malaya is obscure. Both Singapore and Penang, which are tin-smelting districts, have been raided. Another feature of the war in the East is the Japanese threat to the outlet of tin from China along the Burma Road. One result of Japanese intervention in the war will surely be to restrict still further the use of tin in the United States. While stocks of the metal in that country must be very substantial, no chances can be taken. There should continue to be a satisfactory arrival of ore from Bolivia.

COPPER—Although there are no copper deposits or smelting activities in the immediate regions of Japanese aggression, it cannot be said that the copper situation will be entirely unaffected by the new conditions. Deliveries from Chile and Peru to the United States may be disorganised by Japan's naval and air forces operating off the Pacific Coast of North America, while, as far as we in this country are concerned, supplies from the United States may be retarded if the Americans have to transfer some of their naval units of the Atlantic Fleet to service in the Pacific waters. The U.S. authorities are empowered to requisition all stocks of non-ferrous metals in the country, and additional restrictions on the use of copper are likely to be imposed. For a long time Japan was in the market for copper, but there has recently been an embargo on supplies to that country from the Empire and North and South America and, although Japan may not at present be actually short of the red metal, she will not be happily placed in this respect indefinitely. Her domestic output is inadequate to satisfy her requirements even in times of peace.

SPELTER—Urgent needs of spelter are being promptly satisfied, but there is certainly no metal to spare for ordinary domestic usage. Brass makers are very active, while consumption among diecasters is also appreciable. A fair volume of Government business is on hand at the galvanising works, but this trade is not operating to capacity.

LEAD—It does not appear likely that supplies of lead in the United Kingdom will be affected much by the war in the East. It is hoped that shipments from the south of Australia will continue to arrive steadily.

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